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Comparison of serum lipid parameters and serum vitamin B12 levels

Lipid parameters and vitamin B12

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Abstract

Aim: We think that vitamin B12 may affect serum lipid parameters because it is a cofactor of the enzyme that plays a role in fatty acid catabolism, and also because of its association with obesity and increased risk of myocardial infarction in its deficiency. In this study, we aimed to investigate whether vitamin B12 insufficiency, which is common and associated with many diseases, is related to serum lipid parameters. Material and Method: This is a cross-sectional retrospective study. In this retrospective study, data such as serum vitamin B12, glucose, lipid, thyroid function tests, ferritin, and demographic data such as age and gender, were obtained from records of the examinations of the patients who applied to the family medicine clinics, at the northern region in Turkey. The study included 228 patients who underwent concurrent lipid and vitamin B12 analysis and who met the inclusion criteria. Patients who met the exclusion criteria were not included in the study. Results: There was a statistically significant, low positive correlation (r = 0.278, p = 0.001, n = 228) between serum HDL and vitamin B12 levels. There was a statistically significant low negative correlation (r = 0.322, p = 0.001, n = 228) between serum triglycerides and vitamin B12 levels. Discussion: As a result, we can say that serum vitamin B12 levels affect lipid parameters. We may suggest that the risk of diabetes, obesity, and coronary artery disease may increase due to high triglyceride or low HDL levels in the absence of vitamin B12.

Keywords

Vitamin B12; Obesity; Lipid Parameters

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Introduction

Vitamin B12 acts as a cofactor for the two major enzyme systems in the body. Methylmalonic coenzyme A mutase provides conversion of methylmalonic coenzyme A to succinyl coenzyme A. Methylmalonic coenzyme A is formed by the carboxylation of propionyl coenzyme A, which is formed by catabolism of cholesterol, isoleucine and fatty acid, or valine catabolism. Methionine synthase converts the methionine residue homocysteine back into methionine via vitamin B12, which transfers methyl group of folate [1].

Epidemiological studies show that the prevalence of vitamin B12 deficiency in industrialized countries is about 20%. Studies emphasize that the cobalamin deficiency rate varies between 5% and 60% [2]. It is stated that this change shows a correlation with age [3].

In the absence of vitamin B12, megaloblastic anemia occurs due to deficiency of DNA synthesis. In the presence of vitamin B12 deficiency, myelin synthesis deficiency in the dorsal and lateral corticospinal tracts is accompanied by a symmetrical paresthesia in arms and legs, ataxia, loss of strength, spasticity, clonus, and also personality change, restlessness, dementia, memory loss, vibration and position sense loss with taste, smell and vision disorders [4]. Orthostatic hypotension, impotence, urinary retention as well as constipation, diarrhea, atrophic glossitis, and a painful flat red tongue can be seen [2]. Hypotonia, apathy, loss of dynamism, loss of visual contact, lethargy, and coma may be seen in children with mothers with low socioeconomic level or inadequate food intake or with findings of pernicious anemia [5]. In addition to all of these, there are studies suggesting that vitamin B12 deficiency may cause neural tube defects and may also lead to hereditary defects such as cleft palate and cleft lip [6]. It may cause severe clinical symptoms such as depression and psychosis as well as increase the risk of developing high-mortality clinical situations such as myocardial infarction and cardiac shock [7]. Vitamin B12 has been suggested as playing a role in the synthesis of alpha-1 antitrypsin (A1AT), an antiprotease, and may be associated with obesity in A1AT [8]. There are studies suggesting that obesity prevalence has increased in those with vitamin B12 deficiency [9, 10].

We think that vitamin B12 may affect serum lipid parameters because it is a cofactor of the enzyme that plays a role in fatty acid catabolism, and also because of its association with obesity and increased risk of myocardial infarction in its deficiency. In this study, we aimed to investigate whether vitamin B12 insufficiency, which is common and associated with many diseases, is related to serum lipid parameters.

Material and Method

The sample size was calculated to be at least 162 according to the formula n = t2pq / d2. When determining the sample size, p-value was 0.12, q value was 0.88, d value was 0.05, alpha error level was 0.05, and t value was 1.96 according to the error level. This is a retrospective cross-sectional study. It used data such as serum vitamin B12, glucose, lipid, thyroid function tests, ferritin and demographic data such as age and gender obtained from records of the examinations of the patients who applied to the family medicine clinics. Demographic data such as height, weight, marital status, smoking, and alcohol use were not taken into account because they were not included in the patient records. From 28 September 2012 to 17 May 2013, 2287 patients referred to the family medicine clinics, at the northern region in Turkey. Serum vitamin B12 analysis was performed on 503 patients. The study included 228 patients who underwent concurrent lipid and vitamin B12 analysis and met the inclusion criteria. Of these 228 patients, 215 were also simultaneously tested for glucose, 127 for ferritin, and 125 for thyroid function. Patients taking medications for hyperlipidemia, diabetes, obesity and thyroid disease, and receiving iron, vitamin B12, and folate therapy were not included in the study. In addition, because vitamin B12 is stored in the liver and kidneys and is excreted in the kidneys, patients with liver and kidney failure were excluded from the study.

In the analysis of the data, the SPSS statistical software package was used (PASW Statistics for Windows, Version 16.0, Chicago: SPSS Inc.). Categorical data are expressed in terms of numbers and percentages. Numerical data are expressed in averages and analyzed by independent samples t-test in independent groups. Pearson correlation analysis was used for correlation analysis. Skewness analysis was used to assess whether the data fit the normal distribution.

Results

A total of 228 patients between the ages of 15 and 90 years were included in the study. Of the study group, 75.9% (173) were female and 24.1% (55) were male. The average age of women was 52.61, while the average age of men was 51.51.

Serum HDL levels were found to be significantly higher in women than in men at a statistically significant level. Serum ferritin levels were found to be significantly lower in women than in men at a statistically significant level. There was no significant difference between men and women in terms of other serum parameters. The distribution of serum vitamin B12, glucose, lipid, thyroid function tests, and ferritin parameters of the subjects are shown in Table 1.

There was a statistically significant, low positive correlation ($r = 0.278$, $p = 0.001$, $n = 228$) between serum HDL and vitamin B12 levels in both women and men (Table 2).

There was a statistically significant, low negative correlation ($r = 0.322$, $p = 0.001$, $n = 228$) between serum triglycerides and vitamin B12 levels in both women and men (Table 2). There was no significant correlation between serum LDL and vitamin B12 levels.

There was a statistically significant, low positive correlation between serum triglycerides and glucose levels in women. There was no significant correlation between serum triglycerides and ferritin, thyroid function tests and age (Table 3).

There was a statistically significant, low negative correlation between serum HDL and glucose levels in women. There was no significant correlation between serum HDL and ferritin, thyroid function tests, and age (Table 4).

There was a statistically significant, low positive correlation between serum LDL and age parameters in women. There was no correlation between serum LDL and glucose, ferritin, and thyroid function tests in both women and men (Table 5).

Discussion

The lack of availability of demographic data such as height, weight, marital status, smoking, and alcohol abuse weakens the power of our work. However, the average age of both females and males is about 50, the level of ferritin in females is lower than that of males, and the level of HDL is higher; this demonstrates that the sample has a similar distribution to the real population. In addition, the increased presence of serum LDL levels in women with age supports the claim that the sample is similar to the real population.

In our study, there was a positive correlation between serum vitamin B12 and HDL and a negative correlation with triglyceride; this suggests that vitamin B12 affects lipid parameters. Our study supports the findings in the literature. In a study conducted in diabetes patients, a negative correlation was found between serum vitamin B12 and cholesterol, and triglyceride; and a positive correlation was found with HDL [11]. In particular, the association between vitamin B12 and triglyceride parameters suggests that vitamin B12, the cofactor of the enzyme methylmalonil coenzymes mutase A, plays an active role in fatty acid catabolism [1]. In other words, triglyceride levels, which are composed of three fatty acids and one glycerol, are increased in the absence of vitamin B12. There are publications in the literature that show the relationship between Vitamin B12 and triglycerides. It has been suggested that hypertriglyceridemia is reduced efficiently with both fenofibrate and gemfibrozil as well as vitamin B6, B12, and folic acid treatment [12].

Table 1. Comparison of men and women in term of serum vitamin b12, lipid, glucose, ferritin and thyroid function tests.

	Women	Men	Total	Min-max
	Mean ± SD (n)			
Vitamin B12 (pg/ml)	303.01±123.53 (173)	282.65±100.99 (55)	298.10±118.59	82-714
Cholesterol (mg/dl)	202.54±36.87 (173)	198.75±38.25 (55)	201.62±37.16	119-314
Triglycerides (mg/dl)	151.45±74.06 (173)	164.64±73.99 (55)	154.63±74.10	46-438
HDL (mg/dl)	54.79±12.40 (173)*	44.84±11.35 (55)*	52.39±12.86	25-87
LDL (mg/dl)	117.61±31.89 (173)	120.93±36.84 (55)	118.41±33.10	50-230
Glucose (mg/dl)	91.30±16.58 (164)	95.43±24.68 (51)	92.28±18.84	67-242
Ferritin (ng/ml)	43.54±36.24 (107)*	92.10±71.68 (20)*	51.19±46.85	1-281
Free T3 (pg/ml)	3.06±0.33 (101)	3.16±0.27 (24)	3.08±0.32	2.20-4.02
Free T4 (ng/dl)	0.98±0.11 (101)	0.99±0.10 (24)	0.98±0.11	0.72-1.44
TSH (mIU/L)	1.47±1.08 (101)	1.34±1.55 (24)	1.44±1.18	0.01-8.12

SD: Standard Deviation; *Independent samples t testi is significant at the 0.01 level (2-tailed); Min: minumum volue; Max: maximum volue.

Table 2. Correlation of vitamin B12 with different variables and biochemical parameters.

Vitamin B12	Total	Women	Men
	r value; p value (n)		
Age	0.134; 0.054 (228)	0.146; 0.056 (173)	0.083; 0.549 (55)
Cholesterol	0.023; 0.732 (228)	-0.031; 0.686 (173)	0.210; 0.123 (55)
Triglycerides	-0.322; 0.001 (228)*	-0.308; 0.001 (173)*	-0.362; 0.007 (55)*
HDL	0.278; 0.001 (228)*	0.249; 0.001 (173)*	0.358; 0.007 (55)*
LDL	0.062; 0.352 (228)	0.014; 0.853 (173)	0.241; 0.077 (55)
Glucose	0.020; 0.766 (215)	-0.006; 0.936 (164)	0.126; 0.378 (51)
Ferritin	0.041; 0.648 (127)	-0.004; 0.968 (107)	0.202; 0.394 (20)
Free T3	-0.085; 0.345 (125)	-0.140; 0.162 (101)	0.334; 0.111 (24)
Free T4	0.048; 0.595 (125)	0.019; 0.853 (101)	0.246; 0.247 (24)
TSH	-0.006; 0.944 (125)	-0.032; 0.752 (101)	0.083; 0.700 (24)

r value: Pearson correlation; *Correlation is significant at the 0.01 level (2-tailed).

Table 3. Correlation of Serum Triglycerides with different variables and biochemical parameters.

Triglycerides	Total	Women	Men
	r value; p value (n)		
Age	0.062; 0.352 (228)	0.117; 0.124 (173)	-0.094; 0.493 (55)
Glucose	0.164; 0.016 (215)*	0.200; 0.010 (164)**	0.074; 0.806 (51)
Ferritin	0.128; 0.233(127)	0.142; 0.146 (107)	0.106; 0.657 (20)
Free T3	0.108; 0.229 (125)	0.109; 0.277 (101)	0.002; 0.993 (24)
Free T4	0.024; 0.788 (125)	-0.009; 0.932 (101)	0.181; 0.397 (24)
TSH	-0.107; 0.233 (125)	-0.052; 0.606 (101)	-0.270; 0.201 (24)

r value: Pearson correlation; *Correlation is significant at the 0.05 level (2-tailed); **Correlation is significant at the 0.01 level (2-tailed).

Table 4. Correlation of Serum HDL with different variables and biochemical parameters.

HDL	Total	Women	Men
	r value; p value (n)		
Age	0.164; 0.070 (228)	0.134; 0.078 (173)	0.255; 0.061 (55)
Glucose	-0.125; 0.068 (215)	-0.188; 0.016 (164)*	0.104; 0.470 (51)
Ferritin	-0.127; 0.154 (127)	-0.027; 0.785 (107)	-0.218; 0.356 (20)
Free T3	-0.075; 0.407 (125)	-0.023; 0.822 (101)	-0.124; 0.563 (24)
Free T4	-0.087; 0.333 (125)	-0.112; 0.264 (101)	0.040; 0.852 (24)
TSH	0.128; 0.156 (125)	0.107; 0.286 (101)	0.164; 0.444 (24)

r value: Pearson correlation; *Correlation is significant at the 0.05 level (2-tailed).

Table 5. Correlation of Serum HDL with different variables and biochemical parameters.

LDL	Total	Women	Men
	r value; p value (n)		
Age	0.265; 0.001 (228)*	0.339; 0.001 (173)*	0.079; 0.568 (55)
Glucose	0.066; 0.338 (215)	-0.025; 0.751 (164)	0.220; 0.121 (51)
Ferritin	0.154; 0.084 (127)	0.130; 0.182 (107)	0.164; 0.490 (20)
Free T3	0.077; 0.393 (125)	0.019; 0.848 (101)	0.275; 0.193 (24)
Free T4	-0.051; 0.573 (125)	-0.101; 0.313 (101)	0.125; 0.561 (24)
TSH	-0.090; 0.316 (125)	-0.96; 0.341 (101)	-0.071; 0.740 (24)

r value: Pearson correlation; *Correlation is significant at the 0.01 level (2-tailed).

Studies suggest that vitamin B12 deficiency is associated with obesity [8-10]. One of the common lipid abnormalities in obesity is increased triglycerides [13,14]. In our study, there was a negative correlation between serum vitamin B12 and triglycerides. We may associate the increased obesity frequency with vitamin B12 insufficiency in the light of all this information with triglyceride elevation. However, this argument is far from being a strong claim because no analysis has been done with body mass index in our study. Nonetheless, there is information supporting our data in the literature. In one study, there was a positive correlation between serum homocysteine and triglyceride levels in obese and no such correlation was found in non-obese subjects. In addition, homocysteine and triglyceride levels were found to be higher in obese subjects [15]. As known, the most important factor determining serum homocysteine level is vitamin B12 level [16].

In our study, there was a positive correlation between serum glucose and triglyceride and a negative correlation between serum glucose and HDL, especially in women. However, there was no correlation between serum glucose and vitamin B12. These findings indicate that the relationship between serum B12 levels and lipid parameters is independent of glucose metabolism. There is a positive correlation between homocysteine and insulin resistance in women in the literature, and additionally, studies show that homocysteine and HOMA index are high in obese women [17]. There is a positive correlation between homocysteine and insulin resistance in the literature, suggesting a relationship between serum vitamin B12 levels and diabetes.

Conclusion

As a result, we can say that serum vitamin B12 levels affect lipid parameters. We suggest that the risk of diabetes, obesity, and coronary artery disease may increase due to high triglyceride or low HDL levels in the absence of vitamin B12. We suggest that more extensive work should be done on this subject.

Scientific Responsibility Statement

The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.

Animal and human rights statement

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. No animal or human studies were carried out by the authors for this article.

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Conflict of interest

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